(12) UK Patent Application (19) GB (11) 2 318 758 (13) A

(43) Date of A Publication 06.05.1998

(21) Application No 9720010.9

(22) Date of Filing 22.09.1997

(30) Priority Data
(31) 08741887 (32) 31.10.1996 (33) US

(71) Applicant(s)
Motorola Inc

(Incorporated in USA - Delaware)

1303 East Algonquin Road, Schaumburg,
Illinois 60196, United States of America

(72) Inventor(s)
Anthony Scianna
Kenneth John Roback
John C Laugal

(74) Agent and/or Address for Service
Sarah Gibson
Motorola Limited, European Intellectual Property
Operation, Midpoint, Alencon Link, BASINGSTOKE,
Hampshire, RG21 7PL, United Kingdom

(51) INT CL^6
B29C 45/14 69/00

(52) UK CL (Edition P)
B5A AA1 AB1 AB19 A1R214A A1R214H A1R314C6
A1R400 A1R420 A1R439H A1R439X A20T14

(56) Documents Cited
GB 2298387 A EP 0521343 A1 EP 0256499 A2
WO 95/34423 A1 US 4944908 A US 4171563 A
WPI Abstract Accession No. 85-207716/198534 &
JP 60132717 A (TOSHIBA) 15.07.85 (see abstract)

(58) Field of Search
UK CL (Edition O) B5A AA1 AA2 AB1 AB19 AF39E
AT14M
INT CL^6 B29C 45/14 69/00
Online: WPI

(54) **Method for applying conductive shielding to a non-conductive part**

(57) A substantially planar conductive layer (12) provides a conductive shield. The conductive layer (12) is vacuum formed to produce a vacuum formed part. The vacuum formed part is loaded into a mold cavity (20) of a mold machine (10). The mold cavity (20) and the vacuum formed part have a predetermined shape being substantially the same. Non-conductive material (22) is injected into the mold cavity (20) between the conductive layer (12) and a surface (50) of the mold cavity (20) to permit the non-conductive material (22) to bond to the conductive layer (12) to form a finished part (27) having the predetermined shape. The finished part (27) has the non-conductive material (22) on an outer surface (52) of the finished part (27) and the conductive layer (12) on an inner surface (54) of the finished part (27). The finished part (27) is ejected from the mold cavity (20). The abovementioned method (28) reduces processing time, reduces piece part cost and improves the conductive shield's placement and effectiveness over that of the prior art.

The conductive layer 12 is carried on a carrier layer during the moulding process.

The finished part 27 may be a top or bottom housing for a portable radiotelephone handset.

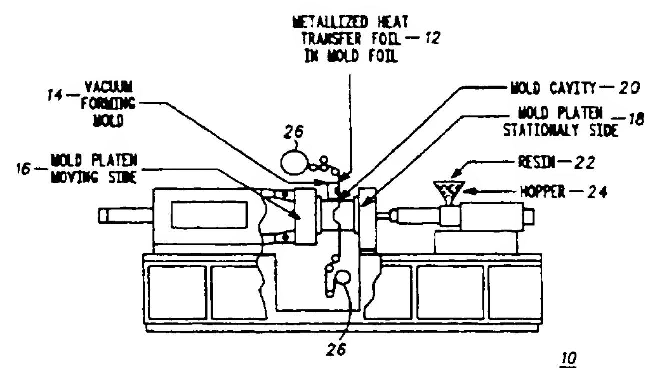


FIG.1

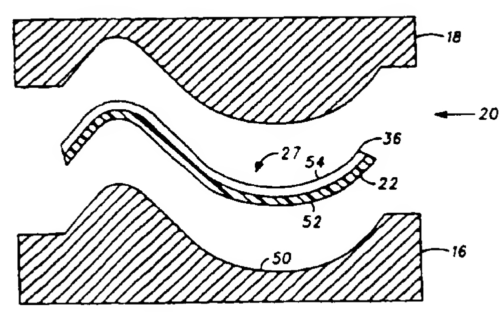


FIG.6 54

GB 2 318 758 A

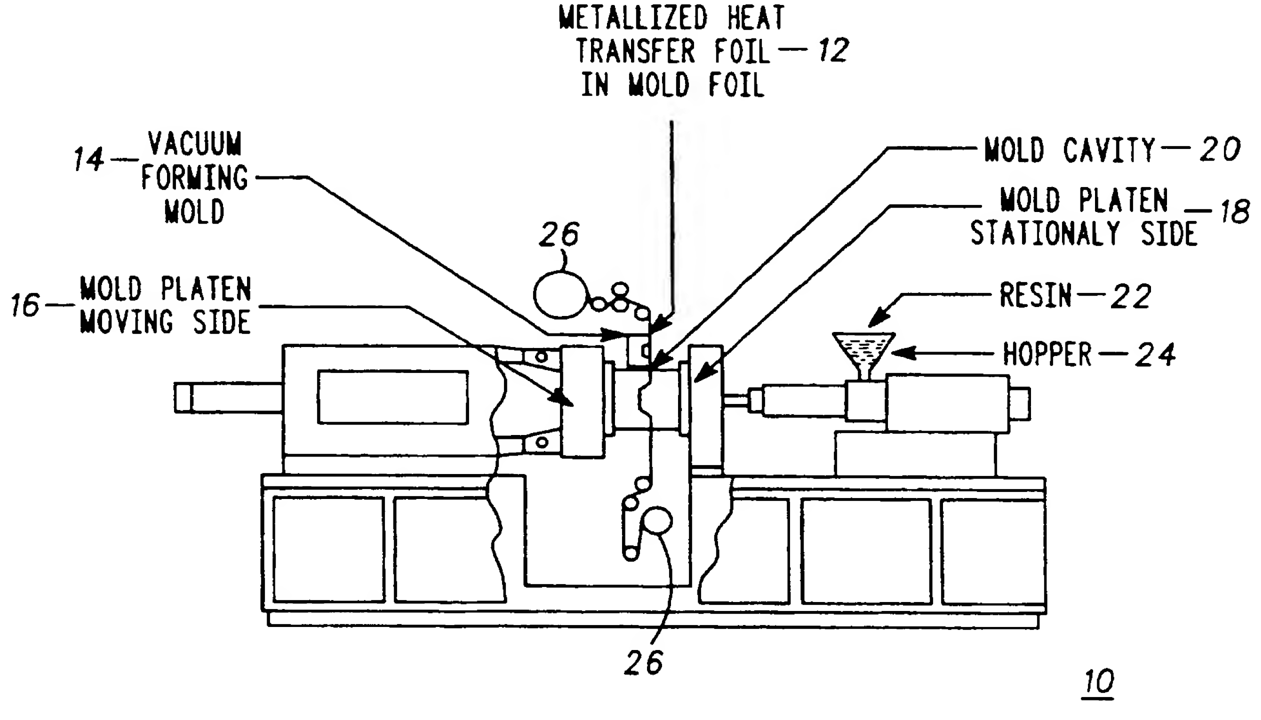

METALLIZED HEAT
TRANSFER FOIL — 12
IN MOLD FOIL
14 — VACUUM
FORMING
MOLD
MOLD CAVITY — 20
MOLD PLATEN — 18
STATIONALY SIDE
26
16 — MOLD PLATEN
MOVING SIDE
RESIN — 22
HOPPER — 24
26
10

FIG.1

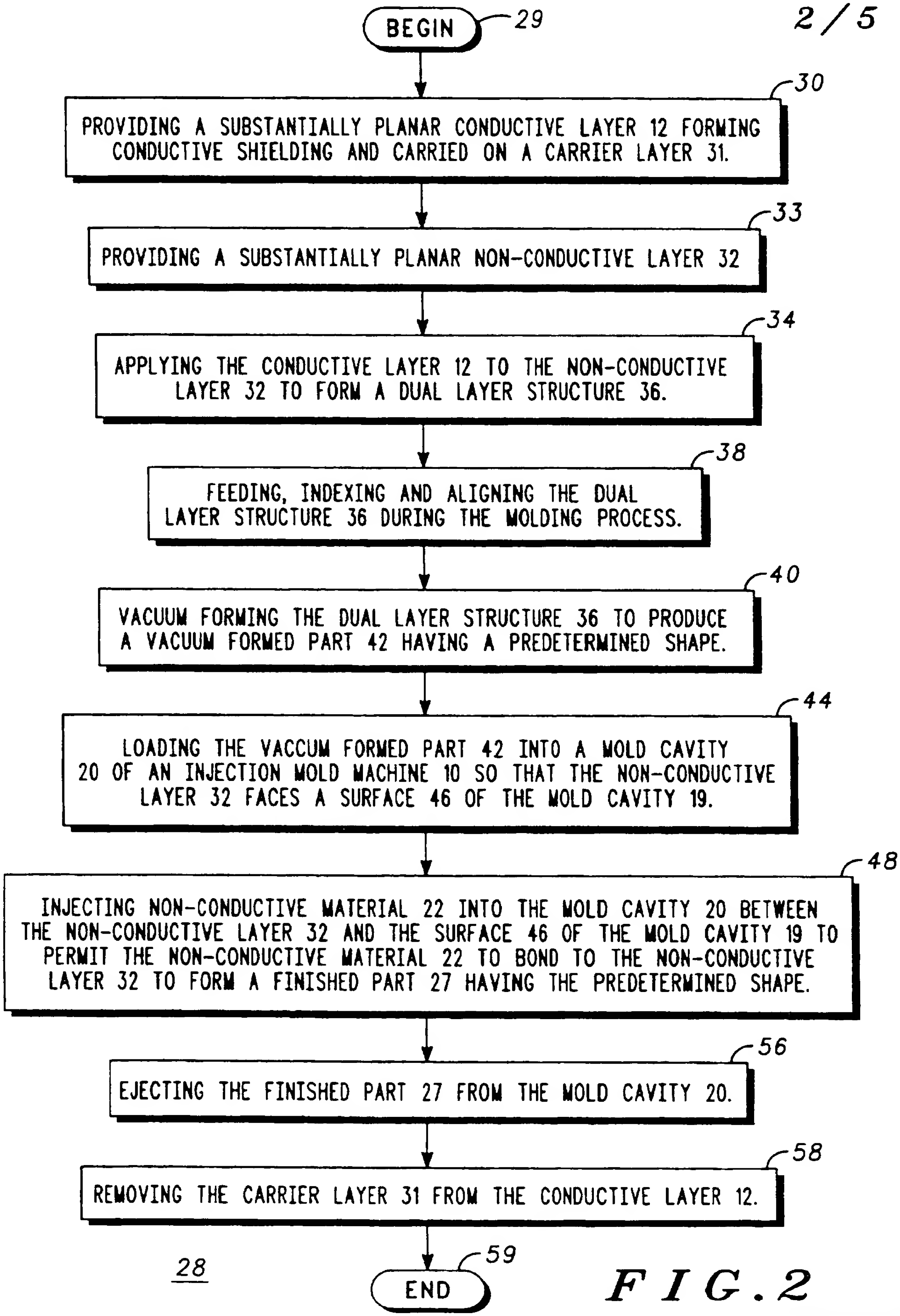

BEGIN
29
30
PROVIDING A SUBSTANTIALLY PLANAR CONDUCTIVE LAYER 12 FORMING CONDUCTIVE SHIELDING AND CARRIED ON A CARRIER LAYER 31.
33
PROVIDING A SUBSTANTIALLY PLANAR NON-CONDUCTIVE LAYER 32
34
APPLYING THE CONDUCTIVE LAYER 12 TO THE NON-CONDUCTIVE LAYER 32 TO FORM A DUAL LAYER STRUCTURE 36.
38
FEEDING, INDEXING AND ALIGNING THE DUAL LAYER STRUCTURE 36 DURING THE MOLDING PROCESS.
40
VACUUM FORMING THE DUAL LAYER STRUCTURE 36 TO PRODUCE A VACUUM FORMED PART 42 HAVING A PREDETERMINED SHAPE.
44
LOADING THE VACCUM FORMED PART 42 INTO A MOLD CAVITY 20 OF AN INJECTION MOLD MACHINE 10 SO THAT THE NON-CONDUCTIVE LAYER 32 FACES A SURFACE 46 OF THE MOLD CAVITY 19.
48
INJECTING NON-CONDUCTIVE MATERIAL 22 INTO THE MOLD CAVITY 20 BETWEEN THE NON-CONDUCTIVE LAYER 32 AND THE SURFACE 46 OF THE MOLD CAVITY 19 TO PERMIT THE NON-CONDUCTIVE MATERIAL 22 TO BOND TO THE NON-CONDUCTIVE LAYER 32 TO FORM A FINISHED PART 27 HAVING THE PREDETERMINED SHAPE.
56
EJECTING THE FINISHED PART 27 FROM THE MOLD CAVITY 20.
58
REMOVING THE CARRIER LAYER 31 FROM THE CONDUCTIVE LAYER 12.
28
END
59

FIG. 2

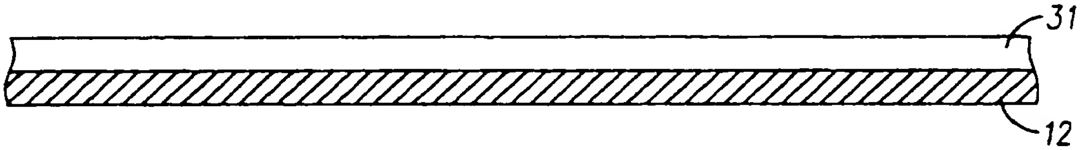


FIG.3 58

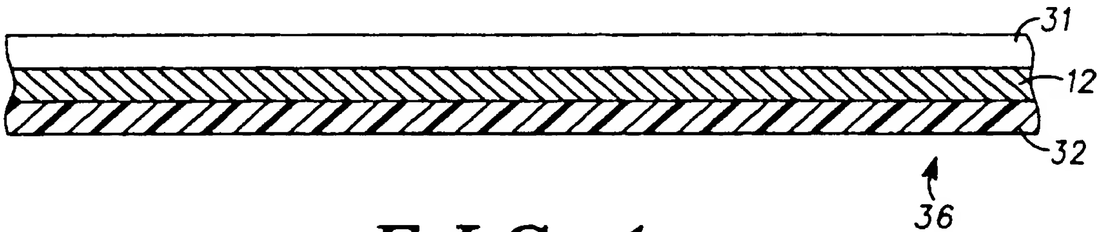


FIG.4 60

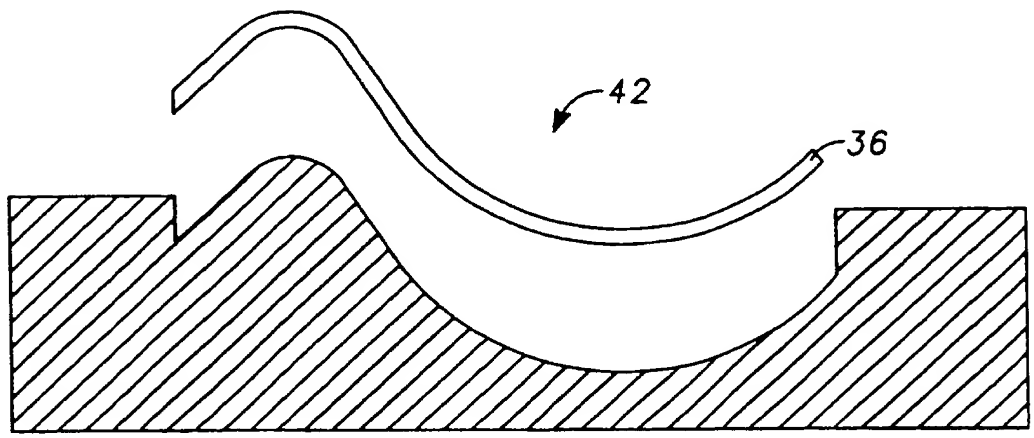


FIG.5 62

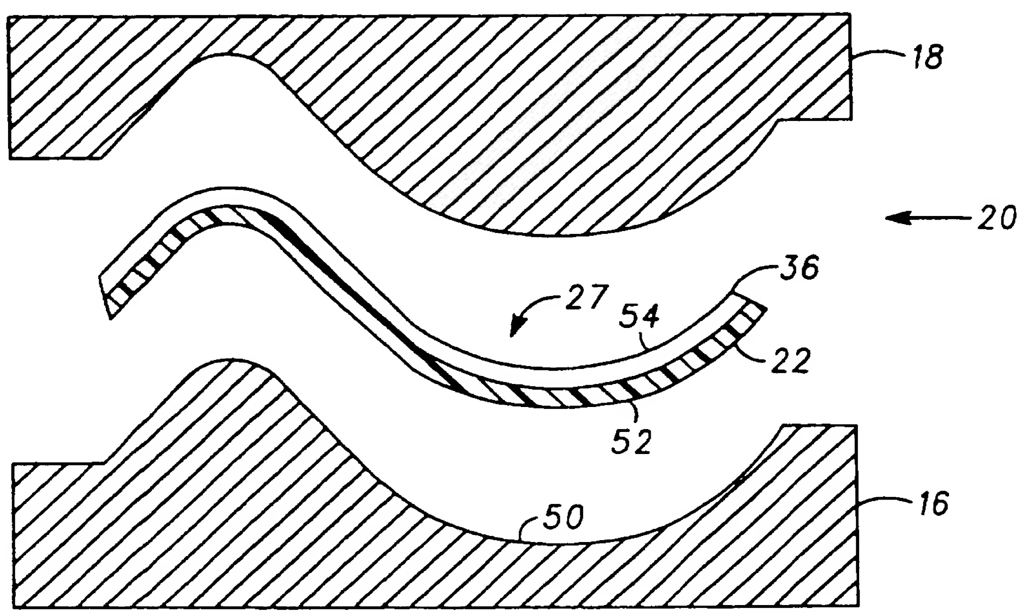


FIG.6 64

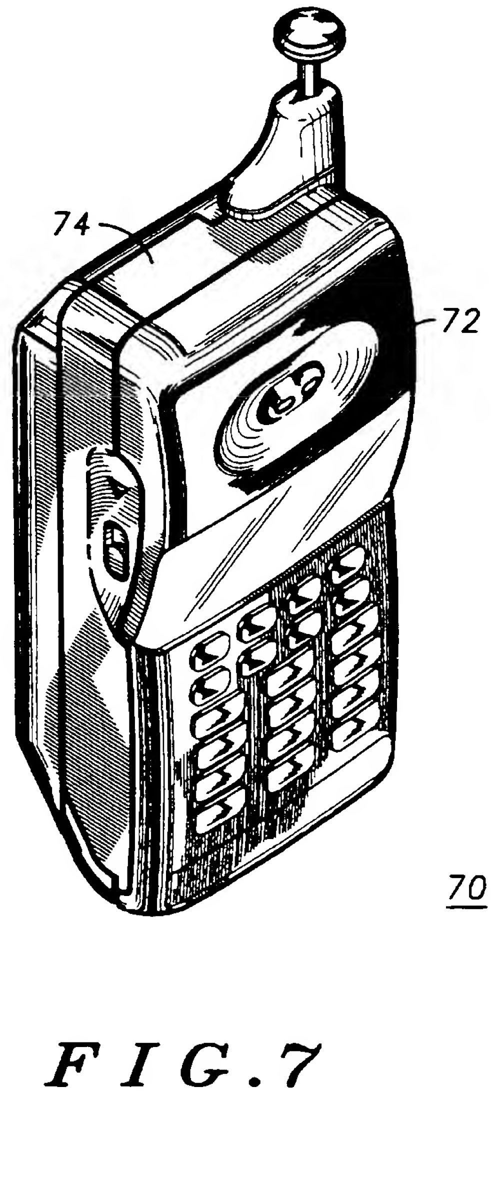


FIG.7

2318758

METHOD FOR APPLYING CONDUCTIVE SHIELDING TO A NON-CONDUCTIVE PART

FIELD OF THE INVENTION

The present invention relates generally to a process for molding parts, and more particularly to a method for applying conductive shielding to a non-conductive part.

BACKGROUND OF THE INVENTION

Parts are molded to provide housings for a variety of products such as electronic equipment. One example of electronic equipment is a radio. Radios include radiotelephones and pagers, for example. Housings for radios contain radio circuitry for transmitting or receiving signals to provide a user of a radio with wireless communications.

Housings for radios typically need conductive shielding to serve several known purposes including reducing the effects of: electromagnetic interference (EMI), radio frequency interference (RFI) and static discharge (SD). The housings are typically non-conductive plastic on their outer surface to provide an aesthetic appearance. The housings [are] typically have the conductive shielding on their inner surface to provide protection against EMI, RFI and SD.

The housings are usually injection molded. Conventional methods used to apply a conductive shield to the inside surface of the injected molded housings include: vacuum metalization, conductive paint spraying, adhesive foil, electroplating, plasma stream and hot metal spraying. Various methods for grounding electronic circuitry to the conductive shield are well known in the art.

A disadvantage of the vacuum metalization, conductive paint spraying, electroplating, plasma stream and hot metal spraying methods is that the inner surface of the injection molded housing must be masked off. The mask blocks the outer surface of the injection molded housing from receiving the conductive shielding. The mask only allows the inner surface of the injection molded housing to receive the conductive shielding. The masking process is usually applied manually to each part and is therefore time consuming and expensive to make. Further, the conductive shielding may be ineffective if the mask is not aligned properly.

A disadvantage of the adhesive-backed conductive foil method is that the adhesive foil is usually manually applied to the inner surface of the injection molded housing. Therefore, this method is also time consuming and expensive to make. Further, the conductive shielding may be ineffective if the adhesive-backed conductive foil is not aligned properly.

Accordingly, there is a need for a method for applying conductive shielding to a non-conductive part which reduces processing time, reduces piece part cost and improves the conductive shield's placement and effectiveness.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view of a machine for molding parts in accordance with the present invention.

FIG. 2 is a flow chart describing steps of a method performed by the machine shown in FIG. 1 in accordance with the present invention.

FIG. 3 is a cross-section view of a planar conductive layer provided in accordance with the steps shown in the flow chart of FIG. 2.

FIG. 4 is a cross-section view of the planar conductive layer shown in FIG. 3 applied to a planar non-conductive layer in accordance with the steps shown in the flow chart of FIG. 2.

FIG. 5 is a cross-section view of the planar conductive layer shown in FIG. 3 applied to a planar non-conductive layer and vacuum formed in a predetermined shape in accordance with the steps shown in the flow chart of FIG. 2.

FIG. 6 is a cross-section view of the vacuum formed part shown in FIG. 5 wherein the planar non-conductive layer is overmolded using an injection

molding process to produce a finished part having a non-conductive outer layer and a conductive inner layer in accordance with the steps shown in the flow chart of FIG. 2.

FIG. 7 is a perspective view of an assembled housing for a portable radiotelephone handset including a top housing and a bottom housing constructed in accordance with the steps shown in the flow chart of FIG. 2.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 is an elevation view of a machine 10 for molding parts in accordance with the present invention. The machine 10 generally comprises a vacuum forming mold 14 and an injection mold 16 and 18 including a moving side mold platen 16 and a stationary side mold platen 18. The moving side mold platen 16 and the stationary side mold platen 18 together form a mold cavity 20 for molding parts having a predetermined shape. A hopper 24 stores resin 22 formed of a non-conductive material which is injected into the mold cavity 20 through the stationary side mold platen 18. A metalized heat transfer foil 12 forms a conductive layer to be processed by the machine 10 in accordance with a method described hereinbelow with reference to FIG. 2. A control mechanism 26 feeds, indexes and aligns the metalized heat transfer foil 12 in accordance with the position and process timing of the vacuum forming mold 14 and injection mold 16 and 18 as it is processed by the machine 10 to produce a finished part 27 as shown in FIG. 6.

FIG. 2 is a flow chart 28 describing steps of a method performed by the machine 10 shown in FIG. 1 in accordance with the present invention. The flow chart 28 describes a method for applying conductive shielding 12 to a non-conductive molded part as shown in FIG. 6. In the preferred embodiment, the conductive shielding 12 to a non-conductive molded part provides a shielded housing for electronic equipment, such as a radio. In the preferred embodiment, the shielded housing is for a cellular radiotelephone. Alternatively, the shielded housing may be used for any radio device such as a pager or a two-way land portable radio, for example.

The method begins with the step 29. The method continues to step 30 of providing the conductive layer 12 which is substantially planar. Preferably, the conductive layer 12 is carried on a carrier layer 31 as shown in FIGs. 3-6 and forms the conductive shielding for the finished part 27 as shown in FIG.

6. The carrier layer 31 provides a way to transport the conductive layer 12 during the molding process. The carrier layer 31 preferably remains attached to the conductive layer 12 throughout the molding process until the finished part is ejected from the mold cavity 20. Thus, the carrier layer 31 advantageously provides automatic handling of the conductive layer 12 during the molding process. In the preferred embodiment, the conductive layer 12 is a layer of metal. The conductive layer 12 has a preferred thickness of 0.0005-0.001 inches and a preferred resistivity of 0.2 Ohms/square. However, any other conductive layer having appropriate conduction characteristics and strength, such as a painted film, may be used.

In the preferred embodiment, the method continues with the step 33 of providing a non-conductive layer 32 as shown in FIGs. 3-6 which is also substantially planar. The non-conductive layer 32 is preferably a film for supporting the conductive layer 12. Alternatively, the non-conductive layer 32 may be a thin layer of non-conductive resin, such as 0.0005-0.001 inches, for example. It is important that the non-conductive layer 32 have proper material characteristics to properly affix itself to both the conductive layer 12 and the non-conductive material 22. Alternatively, the non-conductive material can be directly applied to the conductive layer 12 during the injection molding process.

The method continues with the step 34 of applying the conductive layer 12 to the non-conductive layer 32 to form a dual layer structure 36. The conductive layer 12 and the non-conductive layer 32 are preferably joined before the process of forming the finished part. The dual layer structure 36 would typically be provided by another vendor than the one forming the finished parts. Alternatively, the dual layer structure 36 may be formed during the process of forming the finished part if so desired.

The method continues with the steps 38 of feeding, indexing and aligning the dual layer structure 36. These steps are provided by the control mechanism 26. The step of feeding feeds the dual layer structure 36 through the machine 10 during the process of making the finished part. The molding process includes the steps of vacuum forming, loading, injecting the non-conductive material, ejecting the finished part and removing the carrier layer 31, as will be described hereinbelow. The step of indexing indexes the dual layer structure 36 through the machine 10 in incremental distances during the process of making the finished part. The step of aligning aligns the dual

layer structure 36 with the vacuum mold 14 and the mold cavity 20 of the injection mold 16 and 18 of the machine 10 during the process of making the finished part. The steps 38 of feeding, indexing and aligning the dual layer structure 36 advantageously provide accurate positioning of the conductive layer 12 on the finished part during the automatic handling of the conductive layer 12 during the mold process. Accurate positioning of the conductive layer 12 on the finished part 27 increases the effectiveness of its shielding characteristics.

The method continues with the step 40 of vacuum forming the dual layer structure 36 with the vacuum forming mold 14 to produce a vacuum formed part 42 having a predetermined shape. The predetermine shape is close to but smaller than the predetermined shape of the finished part so that the vacuum formed part 42 can easily fit in the mold cavity 20 and allow space for additional material to be injection molded over the vacuum formed part 42. The vacuum forming mold 14 advantageously forms the dual layer structure 36 in a predetermined shape having extreme shapes and contours that would not be feasible if the forming of the dual layer structure 36 were performed in the injection mold 16 and 18 during the injection molding process.

The method continues with the step 44 of loading the vacuum formed part 42 into a mold cavity 20 of the machine 10 so that the non-conductive layer 32 faces a surface 46 of the mold cavity 20. The mold cavity 20 and the vacuum formed part 42 have substantially the same predetermined shape to permit the mold cavity 20 to receive the vacuum formed part 42.

The method continues with the step 48 of injecting the non-conductive material 22, such as plastic resin, into the mold cavity 20 between the non-conductive layer 32 and a surface 50 of the mold cavity 20 to permit the non-conductive material 22 to bond to the non-conductive layer 32 to form a finished part 27 having the predetermined shape. In the preferred embodiment, the non-conductive material 22 forming the plastic resin is polycarbonate. The finished part 27 has the non-conductive material 22 on an outer surface 52 of the finished part 27 and the conductive layer 12 on an inner surface 54 of the finished part 27.

The method continues with the step 56 of ejecting the finished part 27 from the mold cavity 20. The step 56 of ejecting is performed by opening the

mold cavity 20 and causing the finished part 27 to pop out of the mold cavity 20 in a conventional manner, such as with ejection pins, for example.

The method ends with the step 58 of removing the carrier layer 31 from the conductive layer 12 to remove the carrier layer 31 from the finished part 27. At this point, the finished part has completed the molding and shielding process. In the preferred embodiment, the finished part 27 is a top or bottom housing for a portable radiotelephone handset. Portable radiotelephone handset housings which may be manufactured in accordance with the method of the present invention are shown, for example, in U.S. Patents D350,348 and D348,665. The conductive layer 12, forming the shielding surface, is advantageously applied without any masking operation or manual labor. Therefore, the processing time for the finished part is reduced which in turn substantially reduces the piece part cost of making the finished part 27. Further, the steps of steps 38 of feeding, indexing and aligning the dual layer structure 36 advantageously ensure that the conductive layer 12 is properly aligned with the non-conductive material 22 on the outer surface 52 of the finished part 27 to provide for consistent effective shielding.

FIG. 3 is a cross-section view 58 of the substantially planar conductive layer 12 provided in accordance with the steps shown in the flow chart 28 of FIG. 2. The substantially planar conductive layer 12 is shown with the carrier layer 31 attached to the top side of the conductive layer 12. In the preferred embodiment, the carrier layer 31 is preferably made from polyester.

FIG. 4 is a cross-section view 60 of the planar conductive layer 12, shown in FIG. 3, applied to a planar non-conductive layer 32 in accordance with the steps shown in the flow chart 28 of FIG. 2. The substantially planar conductive layer 12 is shown with the carrier layer 31 still attached. In the preferred embodiment, the non-conductive layer 32 forming the plastic resin is polycarbonate.

FIG. 5 is a cross-section view 62 of the planar conductive layer 12, shown in FIG. 3, applied to the substantially planar non-conductive layer 32 and thereafter vacuum formed to create a vacuum formed part 42 in a predetermined shape in accordance with the steps shown in the flow chart 28 of FIG. 2. A portion of the vacuum mold 14 slightly separated from the vacuum formed part 42 is shown for reference. Note that the shape of the

vacuum formed part 42 is arbitrary in the present application and may take any desirable form.

FIG. 6 is a cross-section view 64 of the vacuum formed part 42 shown in FIG. 5 wherein the planar non-conductive layer 32 is overmolded with non-conductive material 22 using an injection molding process to produce a finished part 27 having the non-conductive outer layer 22 and the conductive inner layer 12 in accordance with the steps shown in the flow chart 28 of FIG. 2. A portion of the mold cavity 20 between the injection mold platens 16 and 18 is shown slightly removed from the finished part 27 for reference. Note that the shape of the finished part 27 is arbitrary in the present application and may take any desirable form.

FIG. 7 is a perspective view of an assembled housing 70 for a portable radiotelephone handset including a top housing 72 and a bottom housing 74. The top housing 72 and the bottom housing 74 are manufactured using the molding process of the present invention as described hereinabove to produce finished parts. The finished part 27 shown in FIG. 6 is representative of the top housing 72 or the bottom housing 74. In the preferred embodiment of the present invention, the molding and shielding process of FIG. 2 is applied to manufacture the portable radiotelephone handset housing 70.

What is claimed is:

CLAIMS

1. A method for applying conductive shielding to a non-conductive molded part, comprising the steps of:

providing a conductive layer which is substantially planar;

forming the conductive layer to produce a formed part;

loading the formed part into a mold cavity of a mold machine, the mold cavity and the formed part having a predetermined shape being substantially the same;

injecting non-conductive material into the mold cavity between the conductive layer and a surface of the mold cavity to permit the non-conductive material to bond to the conductive layer to form a finished part having the predetermined shape, the finished part having the non-conductive material on an outer surface of the finished part which forms the non-conductive molded part and the conductive layer on an inner surface of the finished part which forms the conductive shielding; and

ejecting the finished part from the mold cavity.

2. A method according to claim 1 further comprising the steps of:

providing a non-conductive layer which is substantially planar; and

applying the conductive layer to the non-conductive layer to form the formed part having a dual layer structure;

wherein the step of loading further comprises the step of loading the formed part into the mold cavity of the mold machine so that the non-conductive layer faces the surface of the mold cavity; and

wherein the step of injecting further comprises the step of injecting the non-conductive material into the mold cavity between the non-conductive layer and the surface of the mold cavity to permit the non-conductive material to bond to the non-conductive layer to form the finished part having the predetermined shape, the finished part having the non-conductive material on the outer surface of the finished part and the conductive layer on an inner surface of the finished part.

3. A method according to claim 1 or 2 further comprising the step of:
feeding, indexing and aligning the conductive layer during the steps of providing forming, loading, injecting and ejecting.

4. A method according to claim 1, 2 or 3, wherein the step of forming further comprises the step of vacuum forming.

5. A method according to claim 1, 2, 3 or 4, further comprising the steps of:
carrying the conductive layer on a carrier layer; and
removing the carrier layer from the conductive layer after the step of ejecting is completed.

The Patent Office

Application No:	GB 9720010.9	**Examiner:**	Monty Siddique
Claims searched:	1-5	**Date of search:**	27 November 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B5A (AA1, AA2, AB1, AB19, AF39E, AT14M)

Int Cl (Ed.6): B29C 45/14 69/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2298387 A	(NEC...) Moulding a non-conductive material onto a conductive material	1 at least
X	EP 0521343 A1	(MITSUBISHI...) preformed conductive plate 44 with components and with a non-conductive layer; drawing etc.	1 at least
A	EP 0256499 A2	(SHOWA...)	
X	WO 95/34423 A1	(TELEFONAKTIEBOLAGET...) metallic layer in laminate 3	1 at least
A	US 4944908	(EATON...)	
Y	US 4171563	(U.S.PHILIPS) column 2; drawing etc.	1 at least
Y	WPI Abstract Accession No. 85-207716/198534 & JP 60132717 A (TOSHIBA) 15.07.85 (see abstract)		1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

MANUFACTURE OF SIMULTANEOUS MOLDING AND DECORATING SHEET AND METALLIC GLOSS MOLDING

Patent Number: JP2000043082
Publication date: 2000-02-15
Inventor(s): FUJII KENTARO
Applicant(s):: NISSHA PRINTING CO LTD
Requested Patent: JP2000043082
Application Number: JP19980214680 19980730
Priority Number(s):
IPC Classification: B29C45/14
EC Classification:
Equivalents: JP2943800B2

Abstract

PROBLEM TO BE SOLVED: To give a beautiful metallic gloss decoration by forming a flexible transparent resin anchor layer and a metal thin film layer of an indium on a base sheet having flexibility, and drawing them at a specified draw ratio, thereby performing deep drawing.
SOLUTION: The simultaneous molding and decorating sheet 1 is obtained by forming a flexible and transparent resin anchor layer 3 oriented by 130% or more of an original area at a molding temperature for improving adhesive properties of a metal thin film layer 4 and a thin film layer of an indium are formed on a base sheet 2 similarly oriented with flexibility. An insert material 1 having a design layer or the like provided on the sheet 2 is inserted into a mold 6, mold clamped, melt molding resin is injected in a sealed space between the material 1 and a core mold 6, thereby obtaining a molding integral with the molding of the material 1. Thus, even if the sheet 1 is oriented, no microcrack occurs in the layer 4 and the layer 3, and the metallic gloss molding without impairing a metallic color developing is obtained.

16.03.96

Fig. 1

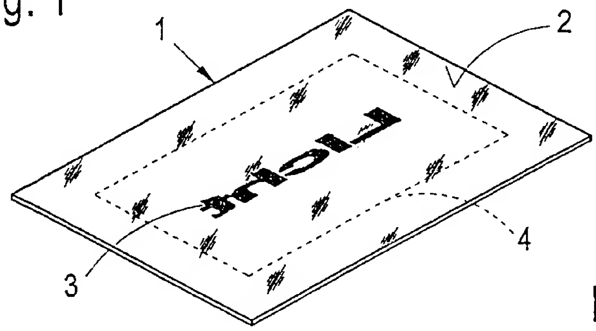


Fig. 2

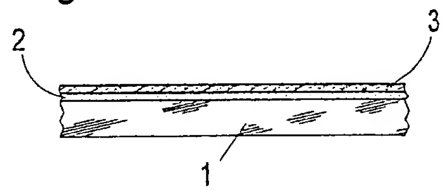


Fig. 3

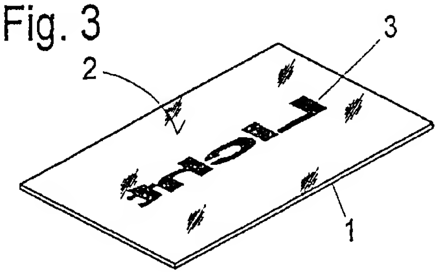


Fig. 4

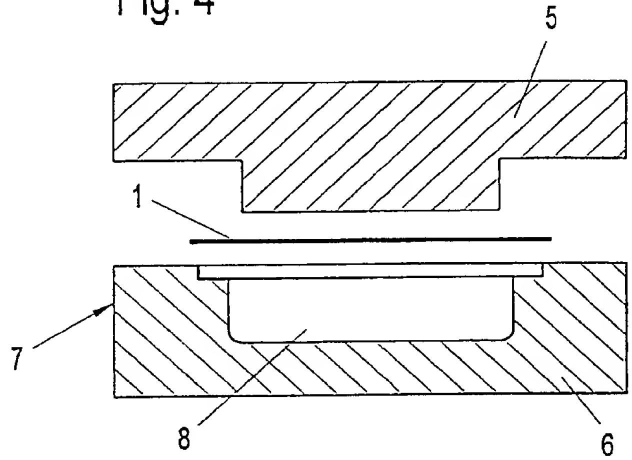


Fig. 5

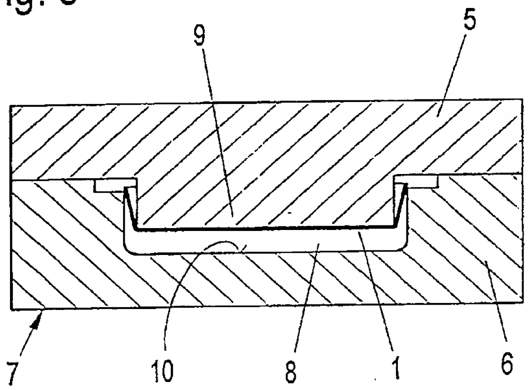


Fig. 6

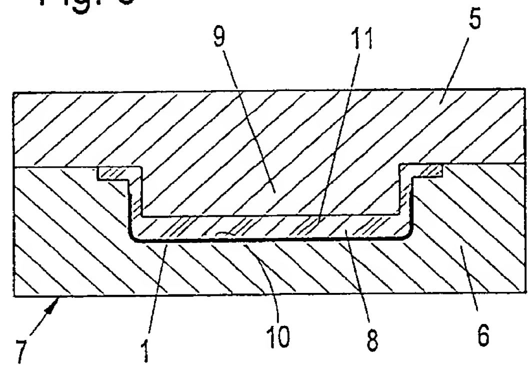


Fig. 7

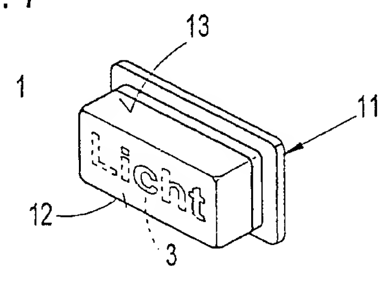
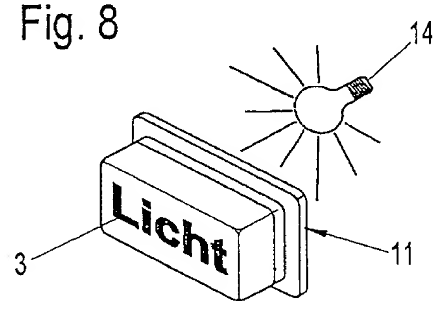


Fig. 8



296 049 10